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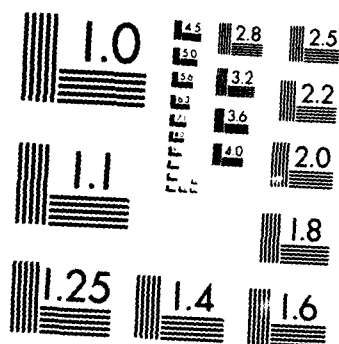
LONG-BASELINE ASTROMETRIC INTERFEROMETERS(U)  
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Submitted by:

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## 28.0 Radio Astronomy

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## 28.1 Galactic and Extragalactic Research

*National Science Foundation (Grant AST 86-17172)*

John Dreher, Bernard F. Burke, C. Carilli, J. Hewitt, G. Langston, Michael Heflin, Samuel Connor, Vivek Dhawan

We have discovered a "counter-jet" in the radio galaxy Cygnus A. This follows the earlier achievement with Perley of the National Radio Astronomy Observatory (NRAO), of the discovery of the relativistic jet that emanates from the active galactic nucleus (a discovery that was made through their new methods of image processing at the the Very Large Array (VLA) at NRAO). A related project, a detailed polarization map of the radio galaxy, has also been completed. A new observing project, one of the largest programs ever undertaken at the VLA, has been begun to extend these methods to a larger selection of radio galaxies.

We have also been searching for new gravitationally-lensed quasars in collaboration with colleagues at Princeton and CalTech. One prime example, Q0023+171, has been discovered and six promising new candidate objects are being studied in greater detail. About 4000 radio maps, taken with the VLA, are being processed as part of their program. A successful series of VLBI experiments has been conducted at 7 mm wavelength, with the intention of establishing that band for standard VLBI operations. A synthesized map at 7 mm of the active galaxy 3C84 (Perseus A) has been prepared and represents the most highly detailed map ever made of that unusual object, with a resolution of 140 micro-arc-seconds. Prof. Burke is also continuing as U.S. principal investigator for the QUASAT satellite, a joint U.S.-European project to establish a VLBI station in space to get higher angular resolution than can be achieved with earth-based VLBI stations alone.

## 28.2 Long-Baseline Astrometric Interferometers

*U.S. Navy - Office of Naval Research (Contracts N00014-84-C-2082 and N00014-86-C-2114)*

David H. Staelin, Michael Shao, John W. Barrett, Lloyd D. Clark, Jr., R. Walter Holm, Matthew J. Kelly, Braden E. Hines

During 1986 construction of the Mark III optical astrometric interferometer continued at the Mount Wilson Observatory. Initial measurements were made of stellar positions using the inner pair of pedestals in the North-South direction; these are separated by 12 meters. These initial crude measurements, performed without the benefit of laser measurements of pedestal position, yielded relative stellar positions over wide angles with sub-arcsecond accuracy. These have further demonstrated the ability of the two-color technique to yield instantaneous stellar positions with a precision more than five times superior to that of the single-color technique.

Three significant subsystems were developed for the Mark III interferometer: an optical delay line, a siderostat control system, and a photon camera star tracker. To adjust the path length of the delay to provide coherence between the two beams, a movable retroreflector was mounted on rails inside a vacuum chamber. Three actuators are used to control the optical path length: a stepper motor, a voice coil, and a piezoelectric transducer. A heterodyne laser interferometer with a resolution of 5 nanometers and a maximum slew rate of 0.6 meters per second monitors the optical path length through the delay line. The rms servo tracking error was approximately 8, 11, and 18 nanometers for delay line velocities of 0, 63, and 790 microns per second, respectively.<sup>1</sup>

The Mark III siderostat subsystems employed open-loop pointing, for which the accuracy was  $\sim 4$  arc minutes. For automatic operation of the Mark III interferometer pointing accuracies of  $\sim 5$ -10 arc seconds were sought. An 8-parameter geometric model was developed to describe the siderostat. A single siderostat was tested at Mount Wilson Observatory, and yielded accuracies better than 10 arc seconds with some restrictions.<sup>2</sup> A multi-beam laser assembly to monitor the position of each siderostat mirror relative to a local invar plate was designed. Work on this system is continuing.

A photon camera star tracker was designed, analyzed and tested. Laboratory testing of the tracker indicated that the rms tracking error in one axis was about 0.1 arc second with a detected photon rate of 13,500 photons per second, and about 0.2 arc seconds for 2500 photons per second.<sup>3</sup>

## References

- <sup>1</sup> R.W. Holm, "A High-Speed, High-Resolution Optical Delay Line for Stellar Interferometry Applications," S.M. Thesis, Dept. of Electr. Eng. and Comp. Sci., M.I.T., Cambridge, Mass., 1986.
- <sup>2</sup> M.J. Kelly, "A Siderostat Control System," S.M. Thesis, Dept. of Electr. Eng. and Comp. Sci., M.I.T., Cambridge, Mass., 1986.
- <sup>3</sup> L.D. Clark, Jr., "A Photon Camera Star Tracker for Stellar Interferometry," S.M. Thesis, Dept. of Electr. Eng. and Comp. Sci., M.I.T., Cambridge, Mass., 1986.

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